ABB Ability™ Asset Performance Management
Improving production availability through predictive analytics
Asset reliability challenges facing energy customers
Higher asset reliability is a key contributor to production availability, process speed and product quality

Market drivers

- **Loss of experience** means less on-site skill and expertise as knowledgeable reliability and maintenance resources retire.
- **Market pressures** drive the need for higher production availability, which drives the need for maximum asset availability.
- **Margin pressures** force producers to continuously find opportunities to reduce maintenance and operational expenditures.
- **Aging assets** And slimmer capital budgets drive producers to find new ways to extend the life of existing assets.
- **Asset complexity** Increases as components become more digital, driving a need for higher knowledge levels.

Energy businesses spend:

- >30% of opex on unplanned maintenance
- 40% of opex on scheduled and unscheduled maintenance, which only covers 20% of their assets.

According to a recent ARC survey, companies have been losing between 3-5% of their production to unplanned downtime.

The need to maximize asset reliability has never been greater

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Maintenance strategies need to be aligned with desired asset performance

Preventive Maintenance (PM): Appropriate for Just 18 Percent of Assets → Yet this has been the focus for most plant maintenance strategies - Doing PM on the other 82 percent can also cause failures!

Autonomous

Prescriptive

Predictive (PdM)

Condition monitoring

Preventive

Reactive

Run to failure

**Description:** Equipment specific algorithms or machine issue and what to do for repair  
**Asset attribute:** Complex assets requiring advanced skills

**Description:** Equipment specific algorithms or machine issue and what to do for repair  
**Asset attribute:** Critical assets where unplanned downtime has business impact

**Description:** Alerts for bad trends or other rules-based logic using a single data value  
**Asset attribute:** Assets where a component failure cascades into big $ losses

**Description:** Service in a fixed time or cycle interval  
**Asset attribute:** Probability of failure increases with asset use of time

**Description:** Run to failure  
**Asset attribute:** Failure is unlikely, easily fixed/replaced, or non-critical

Driving savings through earlier and better equipment performance visibility

When can failures be detected or predicted?

What we need

- A fault condition that is detectable: allows detection with sufficient time to allow corrective action to be taken
- Sufficient instrumentation to allow parameters to be observed
- Information about fault progression, measured data to form a sufficiently accurate “digital twin”, to assess equipment condition.
- A maintenance strategy and procedures that can take advantage of this information
Introducing ABB Ability™ Asset Performance Management
What is it?

Solutions set that combines deep energy experience with predictive analytics to help energy businesses predict, prioritize and reduce risk – from asset to enterprise.

ABB Asset Performance Management building blocks

- Asset Performance Management
  - Fleet performance comparison
  - Indications of potential failures
  - Scalable across plants & asset types

- Condition based maintenance solutions
  - Monitoring, remote assistance, add-on analytic modules, scheduled reports, alerts and notifications

- Smart sensors
  - Neta 21, MNS Digital, CoreTech, MCM 800, AC 500, MachSense, Smart Sensor, WiMon, 3rd party
  - Wireless EX-certified vibration and temperature sensors
  - ABB product specific sensors

- Edge gateway IT/OT integration
  - Fast, scalable connection
  - Vendor agnostic
  - Core starting point

Compare

Compare actual fleet, plant, equipment and component performance with expected performance.

Predict

Uncover potential failures, their associated probability and predicted time to failure.

Optimize

Monitor, analyze, plan and act for optimized maintenance and operation of critical plant equipment.
**Solution 1: ABB Ability™ Edge Insight IT/OT integration**
Enables better asset visibility and decisions by integrating disparate data into one common platform

<table>
<thead>
<tr>
<th>What &amp; Why</th>
<th>Key features</th>
<th>Deployment</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Secure streaming of high-resolution data on-premise to cloud storage, local storage or office distribution. The service connects to industrial field device protocols and translates the data it through a safe, one-way transfer of data. (OT-IT) Save up to 75% of the data normally sent through control system databases</td>
<td>• Fast, scalable connection – correct data to correct people and systems</td>
<td>• Quickly deploy; accommodate for digital business models with small upfront investment</td>
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<tr>
<td>• An enabler for condition monitoring – move up to 97% from site to office</td>
<td>• Vendor agnostic</td>
<td>• Subscription-based lease of software, interfaces and services</td>
</tr>
<tr>
<td>• Flexibility – retaining data ownership, choose what to do with it, open system with no proprietary lock-ins</td>
<td>• Connects to any industrial field protocol, translates to OPC UA or AMQP</td>
<td>• Based on standard connectivity interfaces, further expansion possible</td>
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<tr>
<td>• Ensures accurate and complete information to make better decisions</td>
<td>• Designed with “field plugs” – install only what you need</td>
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Solution 2: ABB Ability™ Condition Monitoring Sensors
Smart Sensor for hazardous and non-hazardous environments

What & Why

- WiMon tracks vibration and temperature data to enable condition-based maintenance of motors, fans, pumps and other rotating machines.
- Makes condition monitoring data available to decision makers, so they can determine the right time for maintenance and reduce or eliminate unnecessary service.
- Early prediction of faults (reduced unplanned outages)
- Reduced frequency of spurious repair trips
- Provides data for remote diagnostics and lifetime predictions

Key features

- **Uncomplicated implementation** – enables simple, wireless installation, easy commissioning and intuitive configuration
- **Trouble-free operation** – features long-life batteries, low maintenance sensors and easy-to-use software
- **Reliable signal transmission** – communicates consistently, through a robust and redundant meshed network to prevent signal interruption,
- **Compliance** – employs vibration monitoring based on ISO 10816 guidelines

Deployment

- Stand-alone
- Third Party / DCS Integration
- Platform independent solution

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Solution 3: ABB Ability™ Asset Insight
Integrating condition monitoring data from underlying systems to visualize anywhere

What & Why
Gathers and presents real-time condition data from different systems into one dashboard so users can reduce time to action by having equipment health data and operational insights available in one place. It is typically a customised solution for each deployment based on standard & new engineered models.

- Easy access to asset health data, anywhere, anytime - directly in your browser
- Can be deployed on the office network or in the cloud
- Facilitates collaboration between customer and ABB domain experts

Key Features
Gives users instant and secure access to the asset data they need to make decisions

- Asset monitor library for monitoring of electrical equipment, rotating machines, control and safety systems.
- Enables integrated access to maintenance advice (FMEA/RCM)
- Aggregated equipment health overview, highlighting equipment with degraded condition
- Worst performers list for key parameters
- Drill-down to equipment detail pages
- Layout diagram for quick identification of location of fault
## Solution 4: ABB Ability™ APM Asset Health

For plant owners balancing competing priorities of cost, performance and risk, ABB’s Asset Health APM enables them to make more informed decisions related to their assets; preventing critical failures while optimizing reliability, availability and asset life cycle costs.

<table>
<thead>
<tr>
<th>Benefits</th>
<th>Key features</th>
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<tbody>
<tr>
<td>Monitor degradation / eliminate failure to drive operational efficiencies</td>
<td>Comparison of actual fleet, plant, equipment and component performance vs. expected performance.</td>
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<tr>
<td>Demonstrable value and ROI (&lt; 1 year)</td>
<td>Expert system + Data science</td>
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<td></td>
<td>Indications of potential failures, associated probability and predicted time to failure;</td>
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<td>RCA and suggested action</td>
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<td></td>
<td>Capability to monitor, analyze, plan and act for optimized maintenance and operation of critical plant equipment</td>
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<td></td>
<td>Scalable deployment across plants and adding asset types</td>
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<tr>
<td>Reduced maintenance costs +30%</td>
<td></td>
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<tr>
<td>Reduced shutdown durations +20%</td>
<td></td>
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<tr>
<td>Increased Turnaround Interval +30%</td>
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<tr>
<td>Improved production uptime +10%</td>
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APM Demonstration & Case Study
Uncover asset health and predict future performance
Flexible, reliable, data-driven -- processed by artificial intelligence engine with multiple algorithms

Process
- Identify the process data to be collected
- Process the data in the machine learning engine
- Get health indicators and predictions

Flexibility: Applicable to all assets (electrical and mechanical), without dependencies on brands and models
Accurate: Precise and reliable indicators of machine health – simple data preprocessing/cleansing capabilities

Identify root cause of failure
Understand the WHY of the faults thanks to a powerful diagnostic logic-modeling engine

Process
- Health indicators calculated by the platform
- Diagnostic logic engine
- Perform failure root cause analysis

Insight: Root cause analysis, answering the question: Why is this equipment going to fail?
Effective: Suggests maintenance approaches
Solution 4: ABB Ability™ APM Asset Health - What kind of data analytics?

A combination of model-based and runtime-based analytics that compare, predict and optimize issues

**Model-based analytics**

\[ \dot{x} = Ax + Bu \]
\[ y = Cx + Du \]

Model predicts known effects even before data is available

**Runtime-based analytics**

Observed behavior based on a runtime data

- Predicts effects that are too uncertain to model (e.g. aging) but are observed in runtime data

**Combined approach**

Collect and analyze data to

- Improve the models
- Detect unknown effects

Combine model-based with runtime-based approach to get deeper insights

- Domain experts partner with data scientists

Reduce unscheduled maintenance costs while decreasing capital and operating expenses by up to 30%
What are the core functions?  
How does it work? High level  
Why customers would find it useful?
Case Study: Enel Green Power (EGP) in Italy

ABB Ability™ APM reduces unplanned failures and maintenance costs with predictive maintenance

**Customer needs**

Enel Green Power develops and manages energy production from renewable sources at 1,200 plants in 29 countries.

The company needed to improve sustainability, reduce maintenance costs and transform its performance, reliability and energy efficiency at 33 of its hydro power plants.

**ABB’s solutions**

Develop predictive maintenance software that could move the hydropower plants to an advanced data-driven management model

Collaborate to improve sustainability of Enel’s operations and transform its performance, reliability and energy efficiency

Deployment of >800 asset models, utilizing data from >190,000 signals

**Scope of delivery**

- ABB Ability™ Asset Performance Management
- Service and domain expert support

**Customer benefits**

- Reduced unplanned downtime
- More focused preventive maintenance
- Improved process efficiency
- Lower fleet maintenance costs
- Higher plant productivity
Why choose ABB
With ABB Asset Performance Management, you:
• Increase efficiency and offset cost pressures.
• Ensure stable, predictable operations.
• Intervene at the right time, in the right measure.
• Avoid unnecessarily servicing or replacing functioning equipment.
• Identify issues before they impact production.
• Increase return on assets as your maintenance organization intervenes just at the point of need. Not before. Not after.

Expected performance improvement with ABB Asset Performance Management:

- Improved production uptime: +10%
- Increased turnaround interval: +30%
- Reduced shutdown durations: +20%
- Decreased maintenance costs: +30%
- Return on investment: <1 year
The leader in Asset Performance Management

Complete portfolio
We offer the most comprehensive asset management portfolio of software, hardware, service and consulting.

Evolving technologies
ABB listens to our customers and is constantly investing in advanced technology solutions such as the ABB Ability™ Asset Performance Management.

Comprehensive support and accountability
Continuity of care with one service agreement to interact with for the entire plant or fleet. Collaborative development with customers to tailor and pilot solutions to ensure value creation.

Deep energy expertise
Proven expertise with more than 35 years of experience in asset management across Energy industries.
ABB Credibility
Proven solutions across the portfolio
Selected references

Edge Insight

2019 Successful Pilots
- 4 Offshore Oil an Gas sites
- 2 Chemical process plants
- 6 Fish Farming and Processing plants

Condition monitoring solutions

Selected reference customers:
Valemon, Aasta Hansteen, Gina Krog, Johan Sverdrup,
Kollsnes, Gudrun (Equinor).
Goliat, ENI. Edvard Grieg, Lundin. Eldfisk + Ekofisk, CP
Valhall, BP. Ormen Lange, Shell. NASR, ADMA OPCO

Sensors

1000 WiMon sensors installed since launch
- BASF Ludwigshafen (Chemicals)
- Goliat FPSO (Oil and Gas)
- Osaka Nippon (Steel)
- Wacker Chemie (Chemicals)
- Südzucker Beteiligungs (Food process)

Asset Health APM

Enel Green Power – Extensive deployment to extend pilot
The same solution components and technique in place in more
than 30 plants in the power generation sector (Hydro CCPP, FFPP,
GT open etc)
Abbreviations and Definitions

Asset – Equipment or other entity requiring maintenance

Equipment – Physical assembly providing specific function(s)

Enterprise Asset Management – management of the maintenance of physical assets of an organization throughout each asset’s lifecycle

Fleet – Collective noun for equipment, typically within a site or enterprise

Maintenance – Intervention required for assets to perform as designed within their operating environment. Provided within frameworks such as RCM (Reliability Centered Maintenance)

Performance – Qualitative measure of an asset’s operation with regard to availability, efficiency and effectiveness

Optimization – Process by which performance is maximized given specific constraints

Reliability – Measure of asset’s ability to perform its intended function

Reliability Engineering – Discipline dedicated to understanding equipment reliability concerned with measures, tools and processes aimed at optimizing performance.

Condition Based Monitoring (CBM) – Use of measured signals to provide insight into equipment health

Predictive Maintenance – Scheduling and execution of maintenance based on theoretical prediction of future health

Fault – Undesirable equipment condition possibly with degraded performance

Failure – Condition rendering equipment unavailable

Health – Freedom from faults or conditions leading to faults

Digital Twin/Model – Computer representation of equipment that predicts an output based on a set of inputs combined with past history

Artificial Intelligence – Mathematical field that studies the synthesis and analysis of computational agents that act intelligently, i.e. flexible, capable of learning (Poole and Mackworth)

Machine Learning – Computer algorithm based upon “training” with data sets. May be supervised (predictor) or unsupervised (provides insight without predictor)
Types of analytics covered

- **Vibration Monitoring**: vibration hardware & software for vibration analysis and harmonics extraction
- **Data Treatment**: input data treatment, validation and substitution policy
- **Performance Monitoring**: calculation of actual efficiency indicator and comparison with expected value. It includes plant, equipment, DCS, alarms
- **Lifetime Monitoring**: stress calculation and lifetime consumption monitoring for boiler and turbine as well as simple count of equipment running hours.
- **Machine Learning**: environment to provide measurements that serve as basis for diagnostic calculations and algorithms to distinguish between sensor and equipment failure
- **Diagnostic & Forecast Indicators**: collection of diagnostic & performance indicators, forecasting analysis.
Asset Health APM
Get health status of asset/equipment and predict future health

Flexible and reliable data driven artificial intelligent engine with multiple algorithms

Benefits:
➢ applicable to all assets (electrical and mechanical), without dependencies on brands and models
➢ Precise and reliable indicators of machines health – simple data preprocessing/cleansing capabilities
Asset Health APM
Identify failure & its root cause analysis

Easy to understand the WHY of the faults thanks to a powerful diagnostic logic modeling engine

Benefits:
- Simple failures root cause analysis, answering the question: «why this equipment is going to fail?»
- Simple management and suggestion of maintenance and repair actions
Asset Health APM

Health Score calculation principle

**Working principle**

Extract features from process data/tags in order to understand if we have an abnormal behaviour due to a sensor fault or a real failure!

Calculate the baseline references from the past data of equipment.

No need of knowing past failures for SW.

Anomalies in the yellow variable identified

Normal behaviour the system learns

Past  Future
Asset Health APM

How does it work? Ask for maintenance as soon as it is convenient

- Software solution to always know current health status of equipments and provide failure predictions.
- Available for engineers and managers. It uses both process and vibrations data for:
  - **Check-Up and diagnosis**: allowing equipment on-line condition monitoring
  - **Prognosis**: identifying the root physical cause of a potential failure
  - **Treatment**: suggesting the remediation to solve the problem
- **Benefit**: reduction of maintenance costs by 20-30 % at least
ABB in Asset Performance Management
Delivering the building blocks to secure Asset integrity and lower cost across an enterprise.

- **Workflow (WFM) and Enterprise Asset Management (EAM) Integration**
  
  (Provided by ABB Ability Ellipse Platform or Third Party)

- **Asset Performance Management (APM Asset Health)**
  
  - Comparison of actual fleet, plant, equipment and component performance vs. expected performance. Indications of potential failures, associated probability and predicted time to failure; RCA and suggested action
  
  - Capability to monitor, analyze, plan and act for optimized maintenance and operation of critical plant equipment
  
  - Scalable deployment across plants and adding asset types

- **Condition based maintenance systems (800xA / Asset Insight)**
  
  - Condition monitoring solutions for equipment types with Asset monitors (normally ABB equipment or using ABB sensors)
  
  - Rotating, Control system & instrumentation, Electrical equipment, Marine systems
  
  - Monitoring, remote assistance, add-on analytic modules, scheduled reports, alerts and notifications

- **Condition monitoring sensors - Add Additional data points**
  
  - ABB: Neta 21, MNS Digital, CoreTech, MCM 800, AC 500, MachSense, Smart Sensor, WiMon, + 3rd party
  
  - ABB have a range of Wireless EX-certified vibration and temperature sensors + ABB product specific sensors that can be deployed on a range of major industrial equipment types

- **Edge Gateway (Edge Insight) > IT-OT Integration**
  
  - Fast, scalable connection – correct data to correct people and systems
  
  - A core starting point! & Vendor agnostic
  
  - Connects to any industrial field protocol, translates to OPC UA or AMQP

  - Designed with "field plugs" – install only what you need
  
  - Buffer storage to minimize loss of equipment data
  
  - Cain access to high resolution process and device data in order to support value add insights.

- **Service & Consulting**
  
  - Maintenance and equipment reliability improvement & Asset integrity consulting
  
  - SME support for static and rotating equipment
  
  - RBI methodology software >100K items. Inspection software >500K items

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Asset Health APM
Predictive maintenance solution to Enel Green Power (EGP)

ABB provides Enel Green Power with predictive maintenance for safer, smarter, and more sustainable hydro operations

ABB is partnering with Enel Green Power to deliver innovative predictive maintenance solutions that will lower maintenance costs and transform the performance, reliability and energy efficiency of its hydropower plants throughout Italy.

A collaborative partnership

Enel Group Renewable Business Line
Global leader in green energy sector managed capacity of more than 43 GW

ABB
Digital leader and long time partner of Enel, engaged to deliver predictive maintenance solutions

Working on conceptualization since 2018

Co-creation through proves pilot project
To develop and test predictive maintenance and advanced solutions on 5 plants in Italy and Spain

Sustainable hydro
Enel was seeking sustainable hydro operations to lower maintenance costs and transform performance, reliability and energy efficiency

Project highlights

33 plants
Of Enel Green Power’s hydroelectric plants across Italy

To be more efficient and predictive
To predictive and condition-based maintenance

With ABB Ability™ Leveraging ABB Ability™ Asset Performance Management

100 units
Across Enel’s hydroelectric fleet

To shift operational models
More from hours-based maintenance

800 asset models
And deployment of ~800 digital asset models

190,000 signals
Including analysis of over 190,000 signals

Gains for Enel

1. Reducing unplanned failures
2. Enabling more efficient planned maintenance practices
3. Savings in fleet maintenance costs and increase plant productivity

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Proven solution for your enterprise

Training — provided by experienced consultants in the field, courses include FMEA, RCM, and general rotating equipment

1. Identification of critical machines
   Critical machines analysis/assessment

2. FMEA/RCM analysis
   Failure modes and availability

3. Maintenance manual/program
   Risk assessment of maintenance strategy
   Gather preventive maintenance activities and time intervals
   Prepare documents with all maintenance activities

4. Define required instrumentation
   Define sensors/solution to monitor failure mode on critical equipment
   Advice on key KPIs to monitor

5. Provision of 24/7 support
   Healthcare engineer (practitioner level)
   ABB SME Unit designer

6. Improve and refine
   Collaboration with domain experts, e.g.: rotating machines
   - In-service modifications for enhancing reliability
   - Beyond design life analysis

7. Analytics & Condition Monitoring
   Asset Health: Indications of potential failures, associated probability and predicted time to failure; RCA and suggested action
   Asset Insight:-gathers condition data in a single view
   Applications for:
   - Control protection of compressors & turbines
   - Adaptive Load sharing
   - Anti-surge control
   - Performance control

8. Instrumentation provision
   Provision of missing instrumentation to fulfill ability to provide condition monitoring as identified in Step 4 gap analysis
Edge Insight Deployment

OT
Field Network  Control/DCS Network

IT
Office Network, Enterprise Network

DCS/UCP/SCADA
[ABB, 3rd party]

OPC DA
OPC ABE
Profinet
Modbus
HartIP
IEC 61850
OPC UA
OCFP

AMQP

EdgeInsight

Site Storage

KPIs
Dashboards
Condition Monitoring
Case / opportunity management
Advanced Trending
Analytics, machine learning